**South Dakota Agricultural Education (AFNR)**

**Academic Integration Activities**

**ACTIVITY #11**

*Wildlife Fisheries students use linear and nonlinear models to solve problems related to fish and wildlife management by comprehending population information.*

**1. Ag Standard**

Wildlife Fisheries, WF 1.1: Apply knowledge of natural resource components to the management of wildlife and fish.

* Dramatize predator and prey population relationships.
* Illustrate the interdependence of organisms within an ecosystem.

**2. Academic Standard**

9-12.A.3.2: Students are able to distinguish between linear and nonlinear models. (Comprehension)

**3. Background Information**

**Linear models** are a function of a linear equation. When graphed onto an x, y axis they form a straight line. They will always conform to the equation y = mx +b, where m = slope (rise/run), x = variable, and b = y-intercept.

**Nonlinear models** are functions of non-linear equations like quadratic or cubic equations. When graphed on an x, y axis they form curved lines. Nonlinear equations will include numerical exponents. For example a quadratic equation looks like y = ax2 + bx, notice the ax raised to the power of 2. The 2 is our exponent. A cubic equation looks like y = ax3 + bx2 + cx, notice the ax is raised to the 3rd power (3 is the exponent) and bx is raised to the 2nd power (2 is the exponent).

**4. Example in Context**

Assume in a habitat that for each fox to live for a year, it needs to consume 60 rabbits. We can express this as r (rabbit population) = 60 (number of rabbits each fox needs to eat) x f (the number of fox in the habitat) to figure out the relationship between rabbit population and fox population. Create a graph that illustrates the number of rabbits needed to carry 1 through 10 fox in that habitat for a given year.

The equation we need is given to us: r = 60f

If we plug in the number of foxes, 1 through 10, we get the chart below.

|  |  |  |
| --- | --- | --- |
| Number of fox (f) | Plug into equation | Number of rabbits needed (r) |
| 1 | r = 60(1) | 60 |
| 2 | r = 60(2) | 120 |
| 3 | r = 60(3) | 180 |
| 4 | r = 60(4) | 240 |
| 5 | r = 60(5) | 300 |
| 6 | r = 60(6) | 360 |
| 7 | r = 60(7) | 420 |
| 8 | r = 60(8) | 480 |
| 9 | r = 60(9) | 540 |
| 10 | r = 60(10) | 600 |

Graphing this data, we get a linear graph as illustrated below.

**5. Guided Practice Exercises**

Assume a student is given the following four charts illustrating the annual population of a species of fish based on algae blooms. Which of the illustrations represents a linear relationship throughout the year?

1 2 3 4

*Answer: 3(it is the only line that is entirely linear)*

**6. Independent Practice Exercises**

Assume that in a given habitat 1,200 prairie dogs were living. They had no predators in this habitat. The South Dakota Department of Game, Fish, and Parks (SDGFP) decided to introduce coyotes into this habitat to decrease the population of prairie dogs. The SDGFP was told that for each coyote they released, it would decrease the population of prairie dogs by 120 annually. They figured this equation y (decrease in prairie dog population) = -120 x (number of coyotes introduced to the habitat), or y = -120x. Create a graph that illustrates how many coyotes it would take to bring the population of prairie dogs below 200 starting with 1 coyote.

(Note: you will have to add an extra step to figure the population after each coyote is introduced because you are starting with a given population and decreasing it with each coyote)

*Answer:*

|  |  |  |  |
| --- | --- | --- | --- |
| *Number of coyotes(x)* | *Plug into equation* | *Decrease in prairie dog population(y)* | *Number of Prairie Dogs*  *(1,200 + y)* |
| *1* | *y = -120(1)* | *-120* | *1,080* |
| *2* | *y = -120(2)* | *-240* | *960* |
| *3* | *y = -120(3)* | *-360* | *840* |
| *4* | *y = -120(4)* | *-480* | *720* |
| *5* | *y = -120(5)* | *-600* | *600* |
| *6* | *y = -120(6)* | *-720* | *480* |
| *7* | *y = -120(7)* | *-840* | *360* |
| *8* | *y = -120(8)* | *-960* | *240* |
| *9* | *y = -120(9)* | *-1,080* | *120* |

Assume a student was given the following 4 graphs illustrating the population of pheasant in a habitat compared to the population of bobcat. Which graph is nonlinear?

**1 2 3 4**

*Answer: 3(it is the only one that does not form a straight line)*

**7. Notes**

A Wildlife and Fisheries teacher could share carrying capacity charts and discuss the type of graphic model used in the illustration to further students’ understanding of linear and nonlinear models.